# Chapter 13

# Measures of Central Tendency

## Learning Objectives

After completing this chapter, you will be able to

- find the mean, median and mode of a set of ungrouped data.
- find the mean, median and modal class of a set of grouped data.


In a class of 39 students, the average weight is 39 kg. After a new student has joined the class, the average weight becomes 40 kg. What is the weight of this new student?

# Preview

[Basic techniques required for this chapter.]

## Basic Technique

**1.** Use a frequency distribution table and a histogram to present the frequency distribution of a set of data

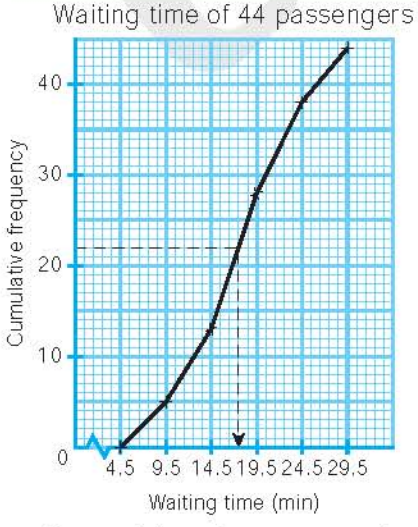
e.g. The following table shows the waiting time of 44 passengers, correct to the nearest minute.

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 13 | 20 | 17 | 23 | 15 | 12 | 26 | 20 | 19 | 25 | 5 | 6 | 25 | 16 | 22 | 8 | 10 | 21 | 28 | 21 | 8 |
| 18 | 16 | 14 | 8 | 13 | 19 | 15 | 12 | 13 | 16 | 22 | 13 | 15 | 19 | 15 | 15 | 20 | 25 | 20 | 26 | 19 | 18 |

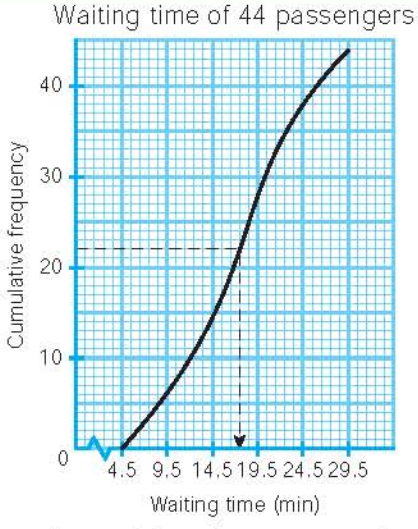
| Waiting time (min) | Class mark (min) | Frequency |
|---|---|---|
| 5 - 9 | 7 | 5 |
| 10 - 14 | 12 | 8 |
| 15 - 19 | 17 | 15 |
| 20 - 24 | 22 | 10 |
| 25 - 29 | 27 | 6 |


**2.** Use a cumulative frequency polygon or a cumulative frequency curve to present a set of data, and find the median from these graphs

| Waiting time less than (min) | 4.5 | 9.5 | 14.5 | 19.5 | 24.5 | 29.5 |
|---|---|---|---|---|---|---|
| Cumulative frequency | 0 | 5 | 13 | 28 | 38 | 44 |




Median waiting time = 17.5 min




Median waiting time = 17.5 min

# 13.1 What is Central Tendency?

The heights (in cm) of the players from two female volleyball teams are shown below. Which team has taller players in general?

Team Greater China: 190, 183, 182, 186, 185, 196, 179, 183

Team South America: 179, 180, 190, 181, 197, 182, 182, 186, 179

Figure 13.1

Once the 'centre' of each set of data is found, we can compare the heights of the players in both teams.

A value representing the central position of the distribution of a set of data is called the **measure of central tendency** for that set of data. The **arithmetic mean** (or **mean**) learned in primary school is one of the measures of central tendency. In this chapter, we shall learn two other measures of central tendency.

**Extension 13.1** Solution

Do you remember the method of calculating the mean in primary school? Using the data in Figure 13.1, determine which team has taller players in general by finding the mean height of each team.

# 13.2 Means

## A Finding means of ungrouped data

In primary school, we learned that the mean is the sum of all the data divided by the number of data.

$$\text{Mean} = \frac{\text{Sum of all the data}}{\text{Number of data}}$$

measure of central tendency 集中趨勢的量度　　arithmetic mean 算術平均數　　mean 平均數

## Example 13.1 Finding the mean

**Additional Example 13.1**

The weights of 5 boys are 45 kg, 52 kg, 32 kg, 68 kg and 46 kg. Find their mean weight.

**Solution**

$$\text{Mean weight} = \frac{\text{Sum of the weights of 5 boys}}{\text{Number of boys}}$$

$$= \frac{45+52+32+68+46}{5} \text{ kg}$$

$$= \frac{243}{5} \text{ kg}$$

$$= \underline{\underline{48.6 \text{ kg}}}$$


**Classwork 13.1** Solution

(a) The weights of 6 girls are 35 kg, 42 kg, 27 kg, 52 kg, 33 kg and 39 kg. Find their mean weight.

(b) The heights of 5 boys are 153 cm, 158 cm, 165 cm, 163 cm and 160 cm. Find their mean height.

## Example 13.2 Finding the mean of repeated data

**Additional Example 13.2**

The stem-and-leaf diagram below shows the distribution of the ages of 15 *scouts*. Find their mean age.

Ages of 15 scouts

| Stem (tens) | Leaf (units) |
|---|---|
| 0 | 8 8 8 9 9 9 9 9 |
| 1 | 1 1 1 3 3 |
| 2 | 0 0 |

**Solution**

**[Analysis: For repeated data, multiplication can be used to speed up the calculation.]**

Sum of the ages of the scouts

$$= 8\times3+9\times5+11\times3+13\times2+20\times2$$

$$= 168$$

$$\therefore \quad \text{Mean age} = \frac{168}{15}$$

$$= \underline{\underline{11.2}}$$

**Classwork 13.2** Solution

The table below shows the sizes of 30 households. Find the mean household size.

| Household size | Frequency |
|---|---|
| 2 | 4 |
| 3 | 6 |
| 4 | 7 |
| 5 | 12 |
| 6 | 1 |

scout 童軍

Additional Example 13.3

## Example 13.3 Finding the overall mean with means of two sets of data given

There are 24 boys and 16 girls in S2A. The mean height of the boys is 165 cm and that of the girls is 152 cm. Find the mean height of all students in the class.

**Solution**

[Analysis: Mean height $= \dfrac{\text{Sum of heights}}{\text{Total number of students}}$]

Sum of boys' heights $= 24 \times 165 \text{ cm} = 3\,960 \text{ cm}$

Sum of girls' heights $= 16 \times 152 \text{ cm} = 2\,432 \text{ cm}$

Mean height of all students in the class

$$= \frac{\text{Sum of students' heights}}{\text{Number of students}}$$

$$= \frac{3\,960 + 2\,432}{24 + 16} \text{ cm}$$

$$= \underline{\underline{159.8 \text{ cm}}}$$

**Classwork 13.3** Solution

(a) The mean height of 5 *starting players* of a female basketball team is 163.5 cm, while that of the 4 *substitutes* is 159 cm. Find the mean height of all players in the team.

(b) Over the 31 days in January, the mean daily income of a shop is \$9 800. Over the 28 days in February, the mean daily income is \$12 800. Find the mean daily income during these two months. (Give your answer correct to the nearest hundred.)

Additional Example 13.4

## Example 13.4 Finding a datum with a known mean

The mean of 4, 6, 9 and $n$ is 7. Find the value of $n$.

**Solution**

$$\text{Mean} = \frac{\text{Sum of all the data}}{\text{Number of data}}$$

$$7 = \frac{4 + 6 + 9 + n}{4}$$

$$28 = 19 + n$$

$$n = \underline{\underline{9}}$$

**Classwork 13.4** Solution

(a) The mean of 5, 7, $x$ and 10 is 8. Find the value of $x$.

(b) The mean of 3, 8, 8, $y$ and 12 is 7.2. Find the value of $y$.

Additional Example 13.5

## Example 13.5 Finding a datum with a known mean

The mean of $a$, $b$ and $c$ is 14, and the mean of $a$, $b$, $c$ and $d$ is 12.5. Find the value of $d$.

**Solution**

$\because$ The mean of $a$, $b$ and $c$ is 14.

i.e. $\dfrac{a + b + c}{3} = 14$

$\therefore$ $a + b + c = 42$

**Classwork 13.5** Solution

(a) The mean of $a$, $b$ and $c$ is 4, and the mean of $a$, $b$, $c$ and $d$ is 5. Find the value of $d$.

(b) The mean of $p$, $q$ and $r$ is 72, and the mean of $p$, $q$, $r$, $s$ and $t$ is 70. Find the value of $s + t$.

starting player 正選球員
substitute 後備球員

$\because$ The mean of $a$, $b$, $c$ and $d$ is 12.5.

i.e. $\dfrac{a+b+c+d}{4}=12.5$

$\therefore$ $a+b+c+d=50$

$d=50-(a+b+c)$

$=50-42$

$=\underline{\underline{8}}$

## B Finding means of grouped data

Figure 13.2 shows the scores of 40 students in a Mathematics examination.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 40 | 51 | 63 | 50 | 43 | 67 | 56 | 65 | 73 | 61 |
| 25 | 65 | 73 | 37 | 75 | 49 | 64 | 31 | 62 | 46 |
| 34 | 73 | 68 | 77 | 48 | 74 | 43 | 93 | 75 | 53 |
| 38 | 57 | 83 | 57 | 82 | 53 | 58 | 71 | 77 | 61 |

Figure 13.2

Since there is a large number of data and they are spread out, we may group the scores into classes and take the class marks to represent all the scores in the corresponding classes. (See Table 13.1)

| Score | Class mark $x$ | Frequency $f$ | $fx$ |
|---|---|---|---|
| 20 - 29 | 24.5 | 1 | 24.5 |
| 30 - 39 | 34.5 | 4 | 138 |
| 40 - 49 | 44.5 | 6 | 267 |
| 50 - 59 | 54.5 | 8 | 436 |
| 60 - 69 | 64.5 | 9 | 580.5 |
| 70 - 79 | 74.5 | 9 | 670.5 |
| 80 - 89 | 84.5 | 2 | 169 |
| 90 - 99 | 94.5 | 1 | 94.5 |
| | Total | 40 | 2 380 |

Table 13.1

Assume each student in this group gets a score of 24.5, so the total score of the students in this group = $24.5 \times 1 = 24.5$.

$34.5 \times 4 = 138$

$$\text{Mean score} = \frac{\text{Sum of all scores}}{\text{Number of students}}$$
$$= \frac{2\ 380}{40}$$
$$= 59.5$$

Since we have not considered every datum after grouping the data, the mean obtained is only an approximate value. However, this method is still acceptable because grouping can reduce workload when many data are involved, and the approximate value obtained is good enough to show the central tendency of the data.

If we add up all scores without grouping them into different classes, we will find that the mean score is 59.275.

## Extension 13.2

Solution

**(a)** Complete the following table based on the data in Figure 13.2 and find the mean score.

| Score | Class mark $x$ | Frequency $f$ | $fx$ |
|---|---|---|---|
| 20 - 39 | | | |
| 40 - 59 | | | |
| 60 - 79 | | | |
| 80 - 99 | | | |
| | Total | | |

Mean score = _____

**(b)** Is the mean obtained in **(a)** the same as the mean obtained before (i.e. 59.5)?

***Note:*** **For the same set of data, different means may be obtained under different groupings of classes.**

## Example 13.6 Finding the mean of grouped data

Additional Example 13.6

The table below shows the distribution of the *waistlines* of a group of boys. Find their mean waistline.

| Waistline (cm) | 66 - 68 | 69 - 71 | 72 - 74 | 75 - 77 | 78 - 80 |
|---|---|---|---|---|---|
| Frequency $f$ | 4 | 7 | 15 | 9 | 5 |

### Solution

| Waistline (cm) | Class mark $x$ (cm) | Frequency $f$ | $fx$ (cm) |
|---|---|---|---|
| 66 - 68 | 67 | 4 | 268 |
| 69 - 71 | 70 | 7 | 490 |
| 72 - 74 | 73 | 15 | 1 095 |
| 75 - 77 | 76 | 9 | 684 |
| 78 - 80 | 79 | 5 | 395 |
| | Total | 40 | 2 932 |

$$\therefore \quad \text{Mean waistline} = \frac{2\ 932}{40}\ \text{cm}$$
$$= \underline{\underline{73.3\ \text{cm}}}$$

## Classwork 13.6

Solution

The table below shows the distribution of the blood pressure of 100 people. Find their mean blood pressure.

| Blood pressure (unit) | Class mark $x$ (unit) | Frequency $f$ | $fx$ (unit) |
|---|---|---|---|
| 100 - 109 | | 10 | |
| 110 - 119 | | 17 | |
| 120 - 129 | | 21 | |
| 130 - 139 | | 32 | |
| 140 - 149 | | 12 | |
| 150 - 159 | | 8 | |
| | Total | 100 | |

waistline 腰圍

## Example 13.7 Comparing two sets of data through their means

Additional Example 13.7

The table below shows the number of words in the Chinese compositions written by students in S2A and S2B.

| Number of words | 320 - 339 | 340 - 359 | 360 - 379 | 380 - 399 | 400 - 419 |
|---|---|---|---|---|---|
| S2A | 5 | 7 | 13 | 10 | 3 |
| S2B | 5 | 4 | 12 | 12 | 7 |

**(a)** Find the mean number of words in the compositions of the students in each class. (Give your answers correct to the nearest integer.)

**(b)** By considering the means, which class of students write longer compositions in general?

### Solution

**(a)** [Analysis: Find the class mark for each class first.]

Mean number of words in the composition written by students in S2A

$$= \frac{329.5\times5+349.5\times7+369.5\times13+389.5\times10+409.5\times3}{5+7+13+10+3}$$

$$= \frac{14\ 021}{38}$$

$$= \underline{\underline{369}} \text{ (corr. to the nearest integer)}$$

329.5, 349.5, 369.5, 389.5 and 409.5 are the class marks of each class.

Mean number of words in the composition written by students in S2B

$$= \frac{329.5\times5+349.5\times4+369.5\times12+389.5\times12+409.5\times7}{5+4+12+12+7}$$

$$= \frac{15\ 020}{40}$$

$$= \underline{\underline{376}} \text{ (corr. to the nearest integer)}$$

**(b)** $\because$ The mean number of words in the compositions written by students in S2B is larger.

$\therefore$ The compositions written by students in S2B are generally longer.

## Classwork 13.7

Solution

The table below shows the number of sit-ups done by the students in S2C and S2D in two minutes.

| Number of sit-ups | 20 - 34 | 35 - 49 | 50 - 64 | 65 - 79 | 80 - 94 | 95 - 109 |
|---|---|---|---|---|---|---|
| S2C | 0 | 10 | 7 | 11 | 4 | 4 |
| S2D | 2 | 9 | 10 | 10 | 7 | 2 |

(a) Find the mean number of sit-ups done by students in each class. (Give your answers correct to the nearest integer.)

(b) By considering their means, which class performs better in general?

## Skills Upgrading Corner 13.1

Solution

**1.** The scores of Kobe and Bryant in the last few basketball games are as follows:

Kobe: 18, 36, 25, 38, 30, 22, 19, 23

Bryant: 17, 20, 18, 34, 28, 35, 26, 24, 30, 27

**(a)** Find the mean scores of Kobe and Bryant.

**(b)** By considering the mean scores, who has a better scoring ability in general?

Solution

**2.** Kitty's mean daily expenditure for the period from last Monday to Friday was $35. Her mean daily expenditure for the 7 days of last week was $50. How much in total did Kitty spend last Saturday and Sunday?

Solution

**3.** The table below shows the duration of movies. Find the mean duration. (Give your answer correct to the nearest minute.)

| Duration (min) | 71 - 80 | 81 - 90 | 91 - 100 | 101 - 110 | 111 - 120 | 121 - 130 |
|---|---|---|---|---|---|---|
| Frequency | 12 | 17 | 25 | 14 | 9 | 6 |

## Exercise 13A

### Level 1

**1.** Find the mean of each of the following sets of data.

**(a)** 115, 117, 118, 120, 120, 124

**(b)** 0, 0, 4, 6, 9, 12, 18

**(c)** −8, −6, −1, 0, 0, 4, 10, 19

**(d)** −7°C, −5°C, −1°C, −1°C, −4°C

**2.** Linda's scores in 5 tests are 56, 63, 70, 74 and 81. Find her mean score in these 5 tests.

**3.** The table below shows the number of umbrellas sold in a shop each day last week. Find the mean number of umbrellas sold each day.

| | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|---|
| Number of umbrellas sold | 25 | 10 | 15 | 30 | 12 | 14 | 20 |

4. Mr. Chan's annual income is $189 600. What is his mean monthly income?

5. In 2006, the Hong Kong Observatory recorded 2 627.8 mm of rainfall. Given that there were 365 days in 2006, find the mean rainfall for each day in 2006. (Give your answer correct to 3 significant figures.)

6. Over the last 10 days, the mean time Edmund spent on jogging each day is 27.4 minutes. How long in total did he spend on jogging in those 10 days?

7. The mean daily consumption of fresh water of a city was 265 million cubic metres. Given that there were 365 days in that year, find the total fresh water consumption of the city that year.

8. The net weight of a box of strawberries is 240 g, and the mean weight of the strawberries is 30 g. How many strawberries are there in the box?

9. The monthly income of a household is $36 000, and the mean monthly income of the family members is $7 200. How many members are there in the household?

10. If the mean of 3, $x$, $x$, 4 and 7 is 6, find the value of $x$.

11. The daily expenditure of Mr. Chan on the first 6 days of last week were $320, $120, $100, $128, $181 and $200. If the mean daily expenditure of Mr. Chan last week was $200, what was his expenditure on the last day of last week?

## Level 2

12. If the mean of $a$, $b$, $c$ and $d$ is 12, find the mean of $a$, $b$, $c$, $d$, 16 and 20.

13. The mean of 3, $x$ and $2x$ is 7, and the mean of 3, $2x$ and $y$ is 6. Find the values of $x$ and $y$.

14. Maggie *budgets* $800 for buying 10 Christmas gifts. She has already bought 9 gifts and the mean price is $85. How much should the last gift be at most if she has to stay within the budget?

15. There are 4 members in each team in a Mathematics competition. To go through to the final, the mean score of the members has to be at least 80. The scores of 3 members of a team going through to the final are 76, 74 and 85. At least what score should the fourth member get?

16. The mean of 4 numbers is 15, and the mean of 5 other numbers is 21.3. Find the mean of these 9 numbers.

budget 預算

**17.** The mean weight of 40 students in S2C is 52 kg, and the mean weight of 24 boys in S2C is 58 kg. Find the mean weight of the girls.

**18.** The mean age of the players in a football team is 21. If the 35 year-old *coach* and 51 year-old manager are included, the mean age of the team increases by 2. Find the number of players in the football team.

**19.** The following table shows the length distribution of 20 rods, correct to the nearest cm. Find the mean length of the rods. (Give your answer correct to 3 significant figures.)

| Length (cm) | 276 | 277 | 278 | 279 | 280 |
|---|---|---|---|---|---|
| Frequency | 1 | 3 | 4 | 8 | 4 |

**20.** The following table shows the distribution of the local *Air Pollution Index* (API) in June. Find the mean API. (Give your answer correct to 3 significant figures.)

| API | 50 - 69 | 70 - 89 | 90 - 109 | 110 - 129 |
|---|---|---|---|---|
| Frequency | 7 | 8 | 10 | 5 |

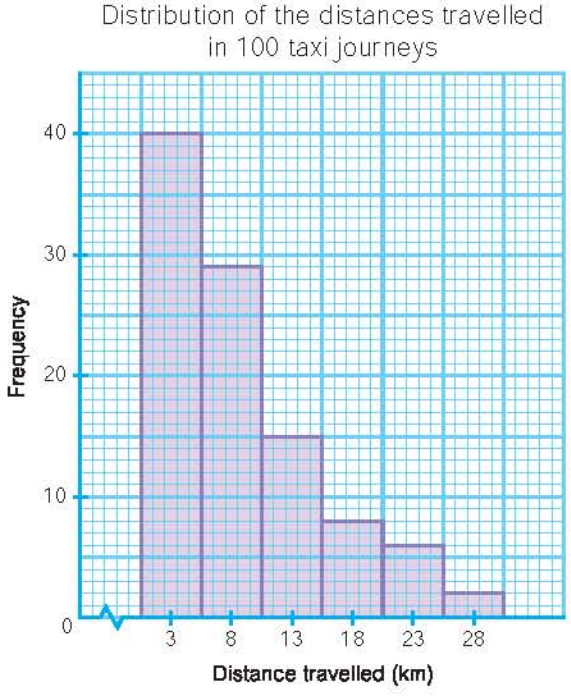
**21.** The following table shows the distribution of the local *Ultra Violet Index* (UVI) at noon in August. Find the mean UVI. (Give your answer correct to 3 significant figures.)

| UVI | 4.0 - 5.9 | 6.0 - 7.9 | 8.0 - 9.9 | 10.0 - 11.9 | 12.0 - 13.9 |
|---|---|---|---|---|---|
| Frequency | 3 | 5 | 8 | 9 | 6 |

**22.** The histogram shows the distribution of the distances travelled in 100 taxi journeys. It is given that the first class interval is 1 km - 5 km.

**(a)** Find the mean distance travelled.

**(b)** If a taxi consumes 0.2 L of petrol for every km travelled, find the mean *petrol consumption* for each journey.




coach 教練　　Air Pollution Index 空氣污染指數
Ultra Violet Index 紫外綫指數　　petrol consumption 耗油量

**23.** The back-to-back stem-and-leaf diagram shows the scores in two Mathematics tests of the students in a tutorial class.

Scores in two Mathematics tests

| First test Leaf (units) | Stem (tens) | Second test Leaf (units) |
|---|---|---|
| 8 5 5 | 2 | 0 5 |
| 9 5 5 2 0 0 | 3 | 0 5 8 9 9 |
| 8 6 5 5 0 | 4 | 6 8 8 |
| 0 | 5 | 0 2 5 7 |
| | 6 | 0 |

**(a)** Find the mean score of each test. (Give your answers correct to 3 significant figures.)

**(b)** By considering the mean scores, have the results of the students in the tutorial class improved in general?

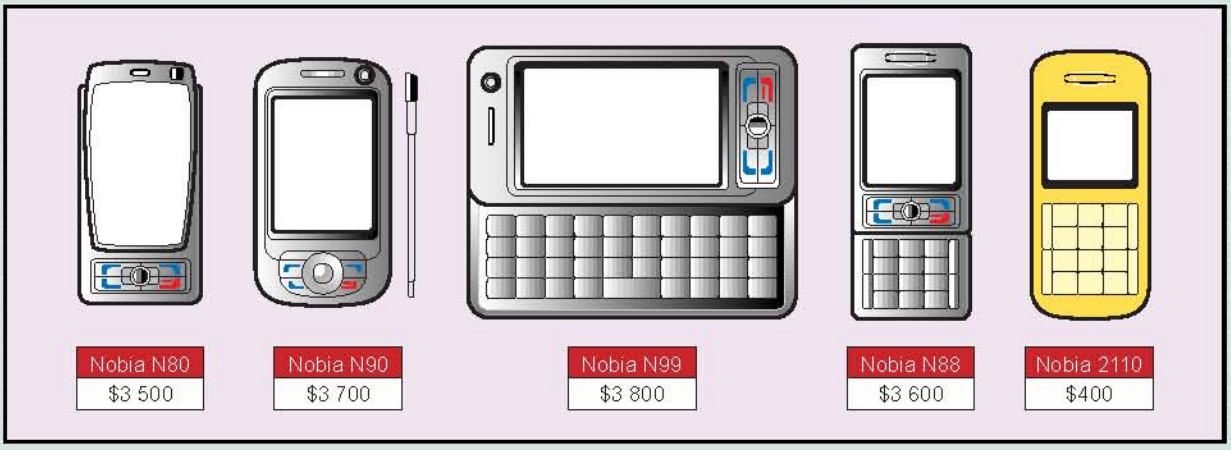
## 13.3 Medians

### A Finding medians of ungrouped data

#### Class Activity 13.1

**Aim:** To investigate the limitations of using a mean to reflect the central tendency

City Telecom sells 5 different models of mobile phones at following prices:




**(a)** The mean price of these five models of mobile phones = _____ Show Ans.

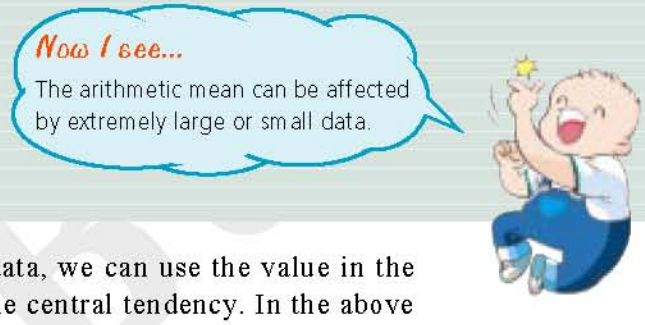
**(b)** The company has posted the following advertisement in a magazine:


Do you think the average price of $3 000 can reflect the prices of the mobile phones in the advertisement? Explain briefly.

Show Ans.

_____

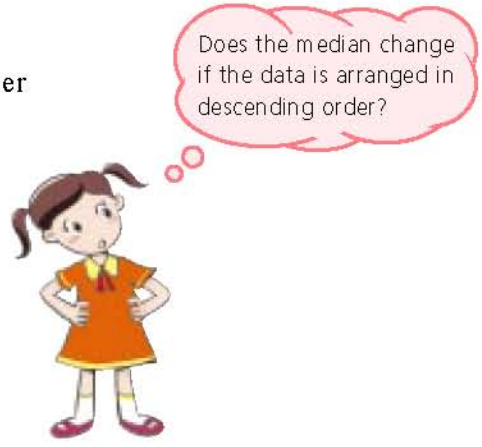
_____




To avoid the impact from extreme data, we can use the value in the middle of the data set to represent the central tendency. In the above Class Activity, we can arrange the prices in ascending order to get

$400, $3 500, $3 600, $3 700, $3 800

The price $3 600, which is in the middle of all data, is a better representation of the central tendency of the prices.





The value obtained in the above method is called the median.

For a set of $n$ data arranged in ascending or descending order,

1. if $n$ is an odd number,
   the median = the middle term;
2. if $n$ is an even number,
   the median = the mean of the two middle terms.

In fact, many large scale statistical surveys use medians to represent the central tendencies of the relevant data. (See Figure 13.3)

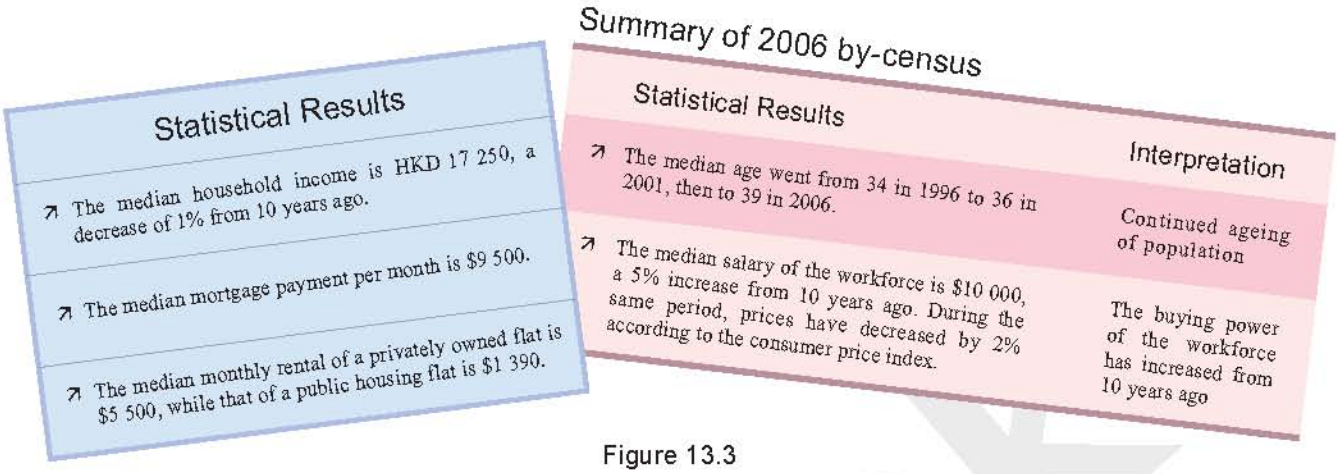



Figure 13.3

## Example 13.8 Finding the median

Additional Example 13.8

Find the median of each of the following sets of data.

**(a)** 113, 424, 92, 110, 120

**(b)** 23, 18, 32, 20, 21, 24, 20, 27, 23, 29

### Classwork 13.8

Solution

Find the median of each of the following sets of data.

(a) 180, 39, 11, 12, 52, 89, 63, 44

(b) 2, 3, 4, 3, 4, 3, 2, 1, 25

### Solution

**(a)** Arrange the data in ascending order:

92, 110, 113, 120, 424

middle term

Median = 113

**(b)** Arrange the data in ascending order:

18, 20, 20, 21, 23, 23, 24, 27, 29, 32

middle 2 terms

$$\text{Median} = \frac{23+23}{2} = 23$$

***Note:*** From the example above, we can see that in a set of $n$ data,

**(a)** if $n$ is an odd number, the middle term is the $\frac{n+1}{2}$th term.

**(b)** if $n$ is an even number, the middle two terms are the $\frac{n}{2}$th and $(\frac{n}{2}+1)$th terms.

Additional Example 13.9

## Example 13.9 Finding the median in real-life situations

The pocket money of 8 boys are \$23, \$15, \$19, \$22, \$20, \$130, \$25 and \$18. Find the median amount of pocket money.

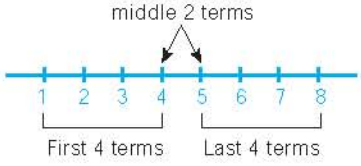
**Solution**

[Analysis: Arrange the amount of pocket money in ascending order: \$15, \$18, \$19, \$20, \$22, \$23, \$25, \$130.]

Median amount of pocket money

$$= \frac{\$20 + \$22}{2}$$

$$= \underline{\$21}$$




### Classwork 13.9

Solution

(a) The time required for 6 students to complete their homework are 120 minutes, 90 minutes, 60 minutes, 298 minutes, 100 minutes and 112 minutes. Find the median time for completing their homework.

(b) The lengths of 9 dolphins are 1.8 m, 1.65 m, 1.7 m, 1.4 m, 2.4 m, 1.6 m, 1.8 m, 1.55 m and 2.1 m. Find the median length of the dolphins.

Additional Example 13.10

## Example 13.10 Finding the median of repeated data

The following table shows the age distribution of the candidates of a piano examination. Find the median age of the candidates.

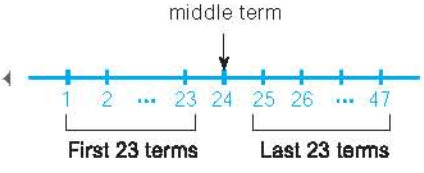
| Age | 16 | 17 | 18 | 19 or above |
|---|---|---|---|---|
| Number of candidates | 24 | 10 | 4 | 9 |

**Solution**

Total number of candidates $= 24 + 10 + 4 + 9 = 47$

Arranging the ages of the candidates in ascending order, the median age is the age of the 24th candidate.

$\therefore$ Median age of the candidates $= \underline{16}$




### Classwork 13.10

Solution

(a) The following table shows the age distribution of the members of a choir. Find their median age.

| Age | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|
| Number of members | 1 | 15 | 10 | 9 | 5 | 2 | 3 |

(b) The table below shows the distribution of the number of homework assignments for S2B over the last 30 school days. Find the median number of assignments.

| Number of assignments | 0 | 1 | 2 | 3 | 4 | 5 or above |
|---|---|---|---|---|---|---|
| Number of days | 2 | 4 | 9 | 6 | 6 | 3 |

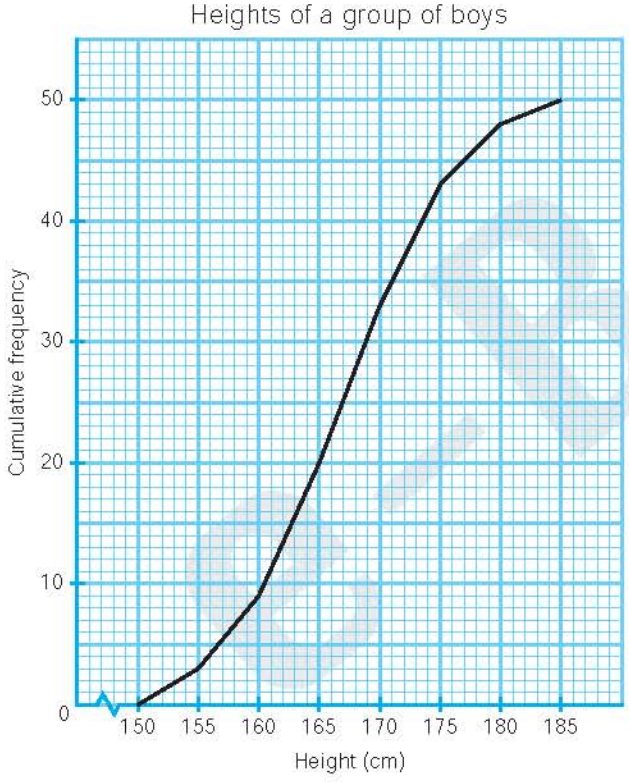
## B Finding medians of grouped data

In Chapter 7 of S2A, we have learned that if the total frequency in a cumulative frequency polygon or a cumulative frequency curve is $N$, the median (i.e. $Q_2$) is the value corresponding to the cumulative frequency $N \times 50\%$(i.e. $\frac{N}{2}$).

### Example 13.11 Finding the median from a cumulative frequency polygon

Additional Example 13.11

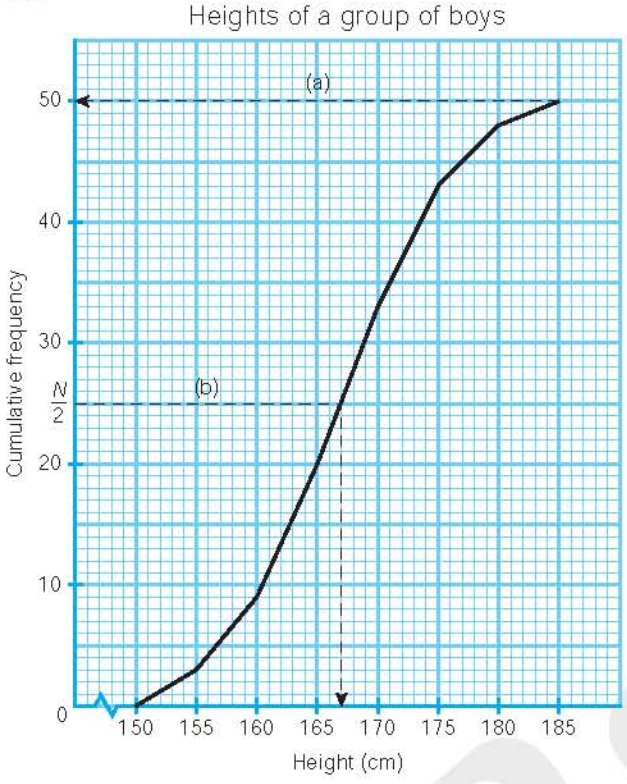
The cumulative frequency polygon below shows the heights of a group of boys.

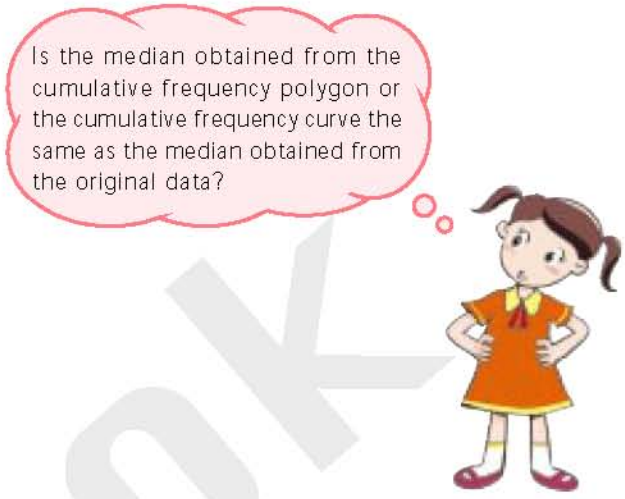



**(a)** Find the number of boys.

**(b)** Find the median height of the boys.

**Solution**




**(a)** From the graph, the number of boys = 50

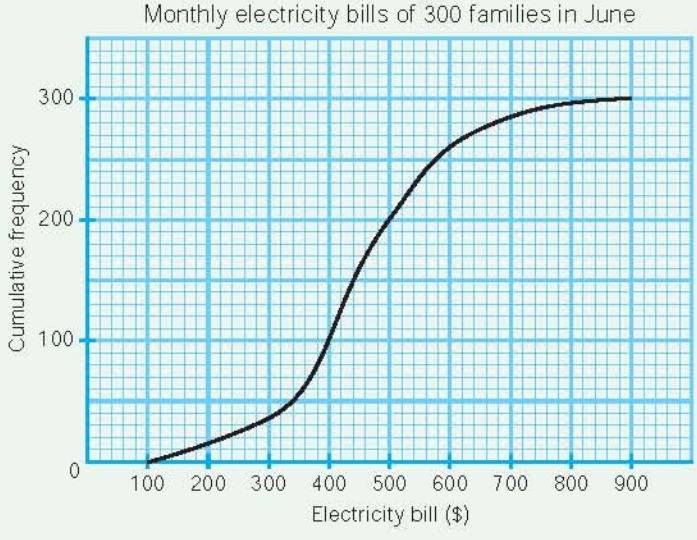
**(b)** [Analysis: Half of the total frequency = $\frac{50}{2}$ = 25, therefore the median height is the value corresponding to the cumulative frequency 25.]

From the graph, the median height = 167 cm

## Classwork 13.11

Solution

The cumulative frequency curve shows the monthly electricity bills of 300 families in June. Find the median monthly electricity bills of these 300 families in June.



## Skills Upgrading Corner 13.2

**Solution**

**1.** Find the median of the following set of data.

$a + 6, a - 4, a + 5, a - 2, a - 7, a + 2$

**Solution**

**2.** The stem-and-leaf diagram on the right shows the price distribution of a bunch of pens.

**(a)** Find the number of pens in the bunch.

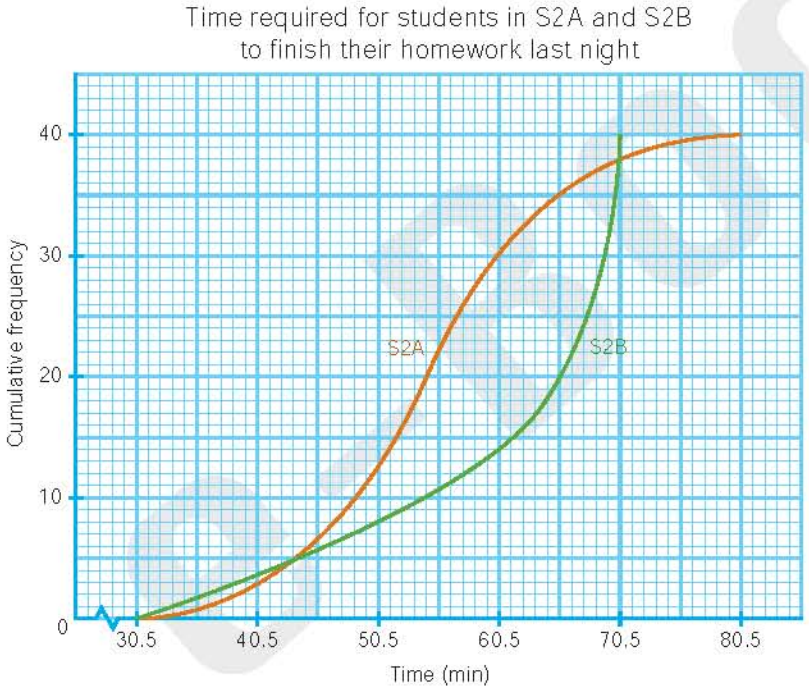
**(b)** Find the median price of the pens.

Prices of a bunch of pens

| Stem ($1) | Leaf ($0.1) |
|---|---|
| 1 | 8 8 9 |
| 2 | 0 0 2 5 5 5 8 |
| 3 | 4 4 5 5 5 8 8 |
| 4 | 5 6 8 8 9 |
| 5 | 0 0 5 |
| 6 | 0 5 5 |
| 7 | 0 0 0 2 5 8 |
| 8 | 0 5 |
| 9 | 8 9 |

**Solution**

**3.** The cumulative frequency curves show the distributions of time required for students in S2A and S2B to finish their homework last night. By considering the medians, students of which class spent more time generally in doing homework last night?




## Exercise 13B

### Level 1

**1.** Find the median of each of the following sets of data.

**(a)** 5, 6, 18, 60, 72

**(b)** 62, 63, 69, 70, 71, 80

**(c)** −5, −4, −4, −2, 0, 0, 1, 3

**(d)** 328, 919, 288, 412, 193, 176

**2.** The results (in seconds) of 8 athletes in a 100 m *dash* are shown below.

10.98, 11.24, 11.06, 12.12, 11.92, 12.06, 11.48, 12.40

Find the median result of the 8 athletes.

**3.** The following shows the number of push-ups done by 9 members of a basketball team in 1 minute.

49, 62, 58, 66, 55, 60, 58, 60, 54

Find the median number of push-ups done.

**4.** The stem-and-leaf diagram shows the distribution of the years of experience of the football players in a team.

**(a)** How many players are there?

**(b)** Find the median years of experience of the football players.

Years of experience of the football players in a team

| Stem (10 years) | Leaf (1 year) |
|---|---|
| 0 | 1 1 3 3 4 4 5 6 6 8 8 9 |
| 1 | 0 0 1 2 2 2 3 4 5 5 6 |
| 2 | 1 |

**5.** The distribution of the number of children in 50 families is shown below. Find the median number of children in these families.

| Number of children | 0 | 1 | 2 | 3 | 4 or above |
|---|---|---|---|---|---|
| Frequency | 8 | 10 | 20 | 7 | 5 |

**6.** A group of video game players are surveyed and the following table shows the number of game discs they have.

| Number of game discs | 5 or below | 6 | 7 | 8 | 9 | 10 or above |
|---|---|---|---|---|---|---|
| Number of game players | 18 | 10 | 16 | 19 | 11 | 14 |

**(a)** How many video game players are surveyed?

**(b)** Find the median number of game discs the players have.

**7.** The temperatures of different districts in Hong Kong at noon in a day are shown below.

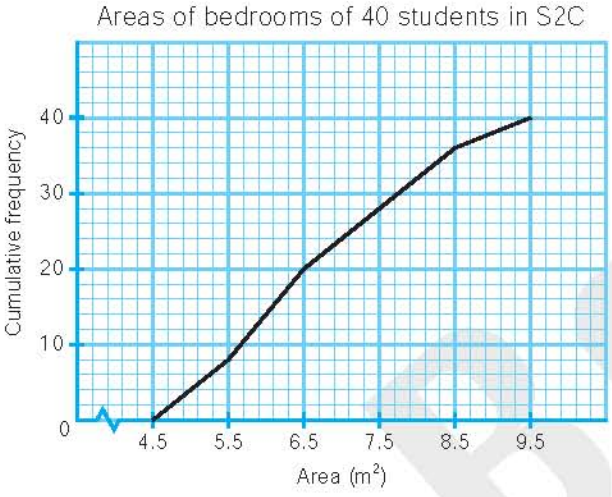

dash 短跑

**(a)** Complete the following table.

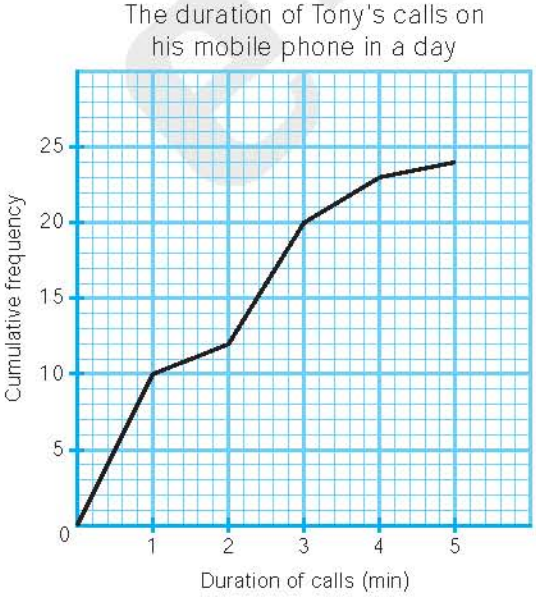
| Temperature (°C) | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|---|---|---|
| Tally | | | | | | | | |
| Frequency | | | | | | | | |

**(b)** Find the median temperature in Hong Kong at noon in that day.

**8.** The following cumulative frequency polygon shows the areas of the bedrooms of 40 students in S2C. Find the median area of bedrooms of the students.




**9.** The following cumulative frequency polygon shows the duration of Tony's calls on his mobile phone in a day.



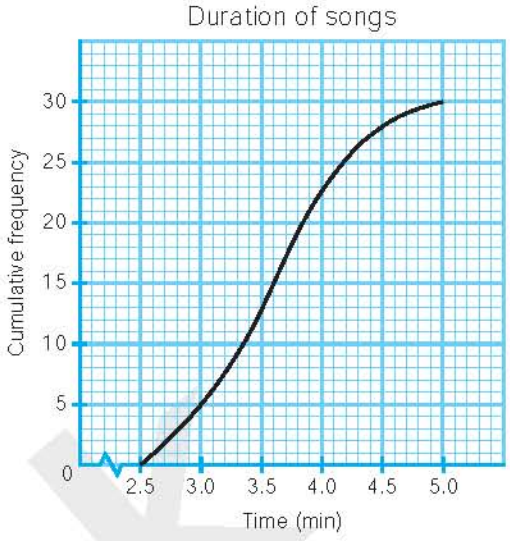

**(a)** Find the total frequency.

**(b)** Find the median duration of the calls.

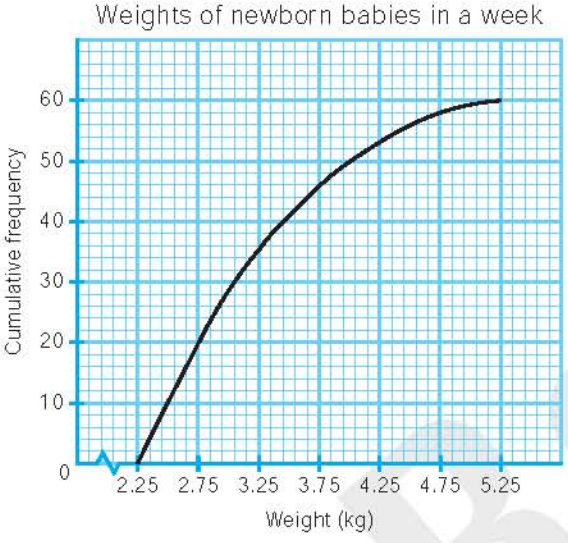
**10.** The given cumulative frequency curve shows the duration of the songs from a *pop album*.

**(a)** How many songs are there in the album?

**(b)** Find the median duration of the songs.




**11.** The given cumulative frequency curve shows the weight distribution of newborn babies in a week. Find their median weight.




## Level 2

**12.** Patrick played 4 games of bowling. His scores were 180, 230, 210 and 94.

**(a)** Find his mean score.

**(b)** Find his median score.

**(c)** According to the results of **(a)** and **(b)**, which of the measures, mean or median, better reflects the central tendency? Explain briefly.

**13.** The number of goals scored by a football team in each game during February and March are shown below.

February: 2, 1, 0, 3, 1

March: 4, 3, 0, 1, 1, 2

**(a)** Find the median number of goals in February.

**(b)** Find the median number of goals in March.

**(c)** Find the median number of goals from February to March.

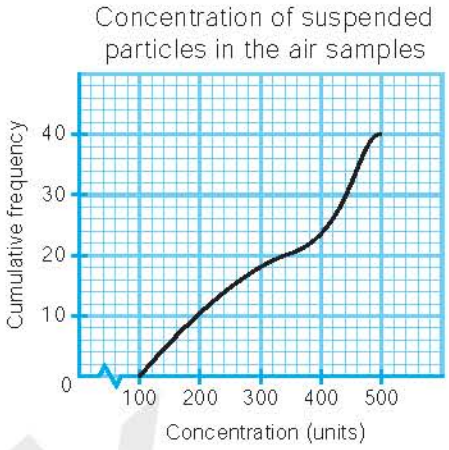
pop album 流行曲專輯

**14.** The cumulative frequency curve shows the *concentration of suspended particles* in the air samples collected in different places.

**(a)** How many air samples are collected?

**(b)** Find the median concentration of suspended particles in the air in these areas.

**(c)** If the safety limit for the concentration of suspended particles in the air is 180 units, does the median concentration of suspended particles in the air exceed the safety limit?




**15.** The cumulative frequency curves show the heart rates of two groups of people after jogging 1 000 m.

**(a)** Find the median heart rate of each group.

**(b)** According to the results of **(a)**, which group of people has higher heart rates after jogging?


**16.** Consider a set of numbers 4, 5, 10, 12, $x$.

**(a)** If the mean is 8,

**(i)** find the value of $x$.

**(ii)** find the median of this set of numbers.

**(b)** If the mean is 11,

**(i)** find the value of $x$.

**(ii)** find the median of this set of numbers.

**17.** It is given that $x$ is a positive integer. If the median of 2, 3, 6, $x$ and $x + 2$ is 3, find all the possible values of $x$.

**18.** The table below shows the prices of 20 different magazines.

| Price ($) | 8 | 10 | 12 | 15 | 20 | 35 |
|---|---|---|---|---|---|---|
| Frequency | 2 | 3 | $x$ | $y$ | 4 | 2 |

**(a)** If the median price of the magazines is \$13.5, find the values of $x$ and $y$.

**(b)** If the median price of the magazines is \$12, write down two sets of possible values of $x$ and $y$.

concentration of suspended particles 懸浮粒子濃度

# 13.4 Modes and Modal Classes


## A Finding modes

The shoe sizes of 2 000 people are as follows:

| Size | 5.5 | 6 | 6.5 | 7 | 7.5 | 8 |
|---|---|---|---|---|---|---|
| Number of people | 100 | 200 | 700 | 600 | 300 | 100 |

Table 13.2

For manufacturers, mean and median shoe sizes are not important pieces of information. They concern about the most popular shoe size. According to Table 13.2, the most popular shoe size is 6.5, and thus this size should be produced more.

The mean and median are 6.775 and 6.75 respectively but they are not the standard sizes. Therefore, they are not important to the manufacturers.

In statistics, the most frequent item in a set of data is called the **mode**.

> The mode of a set of data is the item with the highest frequency.

### Example 13.12 Finding the mode

**Additional Example 13.12**

Find the mode of each of the following sets of data.

**(a)** 2, 3, 3, 4, 5, 6, 7

**(b)** 11, 11, 11, 12, 13, 14, 14, 14, 15, 15

**(c)** The collar sizes of the shirts of 50 men are as follows:

| Size (cm) | 34 | 36 | 38 | 40 | 42 | 44 |
|---|---|---|---|---|---|---|
| Frequency | 7 | 19 | 10 | 8 | 5 | 1 |

**Solution**

**(a)** [Analysis: Number 3 appears twice while the others appear only once.]

Mode = 3

**(b)** [Analysis: There are two modes, 11 and 14, because they both have the highest frequency.]

Modes = 11 and 14 ◂ There may be more than one mode.

**(c)** Mode = 36 cm

We cannot find the mean and median of some data distribution, such as hobbies and types of objects. In such cases, the mode can be used to reflect the central tendency of these data.

### Classwork 13.12

**Solution**

Find the mode of each of the following sets of data.

(a) 4, 5, 5, 6, 6, 6, 7

(b) 21, 21, 22, 22, 22, 23, 23, 23, 29, 32

(c) 85, 57, 72, 80, 85, 57, 57, 88, 80, 78

(d)

| Score | Number of people |
|---|---|
| 0 | 2 |
| 1 | 6 |
| 2 | 9 |
| 3 | 4 |
| 4 | 4 |
| 5 | 3 |

mode 眾數

## Example 13.13 Finding the mode

**Additional Example 13.13**

The table below shows the result of a survey about the most favourite types of magazines with secondary school students. What is the mode of the most favourite types of magazines?

| Type of magazine | Frequency |
|---|---|
| Comics | 32 |
| Entertainment | 27 |
| Computers | 27 |
| News | 11 |
| Sports | 23 |


**Solution**

[Analysis: Most people like comics the most.]

The mode of the most favourite types of magazines is comics.

### Classwork 13.13

**Solution**

(a) The table below shows the blood types of 90 people. Find the mode of blood types.

| Blood type | O | A | B | AB |
|---|---|---|---|---|
| Number of people | 35 | 26 | 22 | 7 |

(b) The table below shows the most favourite food with 100 children. Find the mode of the most favourite food.

| Food | Frequency |
|---|---|
| Apple pie | 9 |
| Ice-cream | 29 |
| French fries | 29 |
| Hamburger | 16 |
| Chicken wing | 17 |

## Example 13.14 Comparing two sets of data with their modes

**Additional Example 13.14**

The table below shows the sport shoe sizes of two groups of students.

| Sport shoe size | 5.5 | 6 | 6.5 | 7 | 7.5 | 8 | 8.5 |
|---|---|---|---|---|---|---|---|
| Group A | 8 | 12 | 10 | 5 | 3 | 2 | 0 |
| Group B | 1 | 3 | 6 | 9 | 10 | 7 | 4 |

**(a)** Find the mode of the sport shoe sizes of each group.

**(b)** Assume that the shoe size of a boy is larger than that of a girl of the same age. A and B are two groups of students of the same age, where boys are in one group and girls are in the other. By considering the modes, which group is the group of boys? Which group is the group of girls?

**Solution**

**(a)** The mode of sport shoe sizes of group A is 6.

The mode of sport shoe sizes of group B is 7.5.

**(b)** ∵ The mode of sport shoe sizes of the students in group B is larger.

∴ Group B is the group of boys and group A is the group of girls.

### Classwork 13.14

**Solution**

The table below shows the school uniform sizes of two groups of boys.

| School uniform size | Group A | Group B |
|---|---|---|
| XXS | 0 | 1 |
| XS | 2 | 9 |
| S | 5 | 12 |
| M | 14 | 10 |
| L | 10 | 4 |
| XL | 6 | 1 |

(a) Find the mode of the school uniform sizes of each group of students.

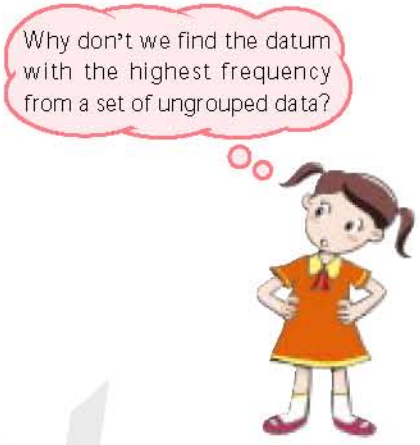
(b) Assume that school uniform sizes for higher form students are larger. As for groups A and B, one of them consists of S1 students, while the other consists of S5 students. By considering the modes, which group is the group of S1 students? Which group is the group of S5 students?

# B Finding modal classes

For grouped data, the class with the highest frequency is called the **modal class**.

> The modal class is the class with the highest frequency.

Modal class is frequently used to describe central tendencies of data in our daily life. For example, fast food shops are interested to know under which age group do most of their customers fall into.




**Additional Example 13.15**

## Example 13.15 Finding the modal class

The table below shows the number of words in an English composition of 40 students. Find the modal class of the number of words.

| Number of words | 230 - 259 | 260 - 289 | 290 - 319 | 320 - 349 | 350 - 379 | 380 - 409 |
|---|---|---|---|---|---|---|
| Frequency | 4 | 7 | 15 | 7 | 6 | 1 |

**Solution**

[Analysis: The frequency of the class interval 290 - 319 is the highest.]

Modal class of the number of words = 290 - 319

### Classwork 13.15

**Solution**

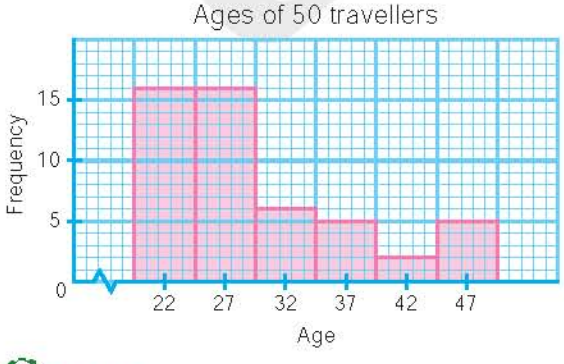
The table below shows the weights of some magazines. Find the modal class of the weights of the magazines.

| Weight (g) | Frequency |
|---|---|
| 100 - 149 | 2 |
| 150 - 199 | 10 |
| 200 - 249 | 13 |
| 250 - 299 | 8 |

**Additional Example 13.16**

## Example 13.16 Finding the modal class from a histogram

The histogram below shows the age distribution of 50 travellers. Given that the first class interval is 20 - 24, find the modal class of the ages.




**Solution**

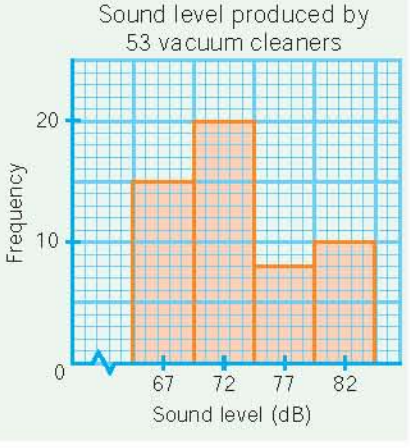
[Analysis: The classes with the highest frequency have the longest bars.]

Modal classes of the ages are 20 - 24 and 25 - 29.

### Classwork 13.16

**Solution**

The histogram below shows the sound level produced by 53 vacuum cleaners. Given that the first class interval is 65 dB - 69 dB, find the modal class of the sound level.




modal class 眾數組

Additional Example 13.17

## Example 13.17 Constructing data with the mean, median and mode given

Write down a set of 5 numbers such that their mean, mode and median are 10, 5 and 12 respectively.

### Solution

Let the 5 numbers be $a$, $b$, $c$, $d$ and $e$ in ascending order.

$\because$ The median is 12.

$\therefore$ $c = 12$

$\because$ The mode is 5.

$\therefore$ At least 2 numbers are 5.

$\therefore$ $a = b = 5$

$\because$ Mean = 10

$\therefore$ $\dfrac{5+5+12+d+e}{5} = 10$

$22 + d + e = 50$

$d + e = 28$

$\because$ $d$ and $e$ are both larger than 12.

$\therefore$ Let $d = 13$, $e = 15$. ◂ $13 + 15 = 28$ satisfies the condition $d + e = 28$.

$\therefore$ The 5 numbers could be 5, 5, 12, 13 and15.

*Note:* The following sets of numbers also satisfy the conditions above: 5, 5, 12, 13.1, 14.9 and 5, 5, 12, 13.3, 14.7

### Classwork 13.17

Solution

(a) Write down a set of 5 numbers such that their mean, mode and median are 8, 9 and 9 respectively.

(b) Write down a set of 6 numbers which are not all the same, but their mean, mode and median are all 10.

## Skills Upgrading Corner 13.3

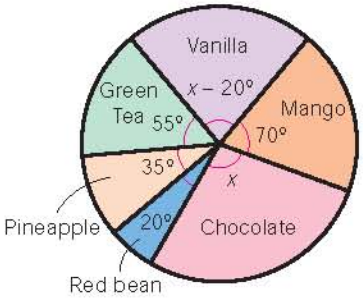
Solution

1. An ice-cream company has surveyed 720 customers for their most favourite ice-cream flavours, and shows the results in the given pie chart.

   **(a)** Find $x$.

   **(b)** Find the mode of the most favourite ice-cream flavours.

Most favourite ice-cream flavours with 720 customers



Solution

**2.** The table below shows the arrival times of 1 000 students yesterday. Find the modal class of the arrival times.

| Arrival time | 7:51 - 8:00 | 8:01 - 8:10 | 8:11 - 8:20 | 8:21 - 8:30 | 8:31 - 8:40 |
|---|---|---|---|---|---|
| Percentage | 10% | 15% | 38% | 32% | 5% |

Solution

**3.** The cumulative frequency distribution table shows the age distribution of customers of a fitness centre.

| Age less than | 25.5 | 30.5 | 35.5 | 40.5 | 45.5 | 50.5 |
|---|---|---|---|---|---|---|
| Cumulative frequency | 18 | 43 | 67 | 87 | 92 | 100 |

**(a)** Given that the class interval of the first class is 21 - 25, complete the following table.

| Age | 21 - 25 | | | | | |
|---|---|---|---|---|---|---|
| Frequency | 18 | | | | | |

**(b)** Find the modal class of the ages of the customers.



## Exercise 13C

### Level 1

**1.** Find the mode of each of the following sets of data.

**(a)** 6, 6, 7, 8, 8, 8, 19, 23

**(b)** 6, 4, 9, 6, 5, 6, 11, 6

**(c)** 11, 13, 14, 14, 15, 28, 28, 30

**(d)** 2, 6, 8, 10, 25, 8, 2, 25

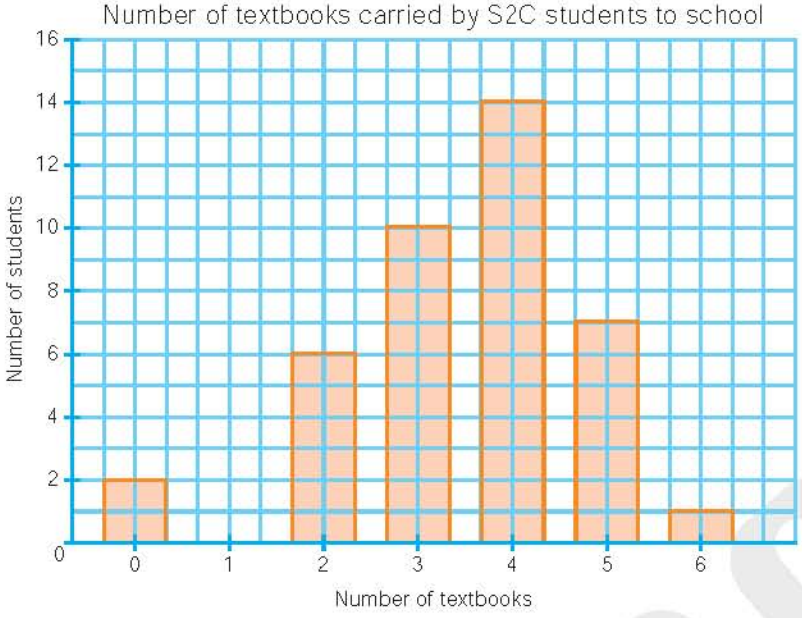
**2.** The table below shows the age distribution of 40 scouts. Find the mode of the ages.

| Age | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|
| Frequency | 10 | 17 | 5 | 5 | 3 |

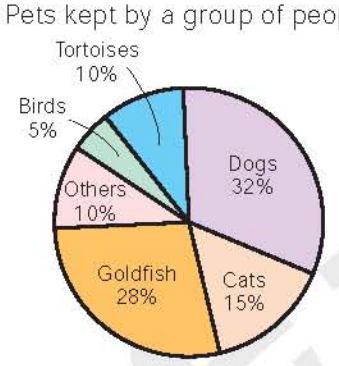
**3.** The table below shows the districts where S2B students live in. Find the mode of these districts.

| District | Kwai Tsing | Tsuen Wan | Tuen Mun | Shatin | Mong Kok | Others |
|---|---|---|---|---|---|---|
| Number of students | 10 | 16 | 5 | 3 | 2 | 4 |

**4.** The bar chart below shows the number of textbooks carried by S2C students to school. Find the mode of the number of textbooks.




**5.** The pie chart below shows the pets kept by a group of people. Find the mode of pets kept.




**6.** The table below shows the distribution of highest daily temperatures in August. Find the modal class of the highest daily temperatures.

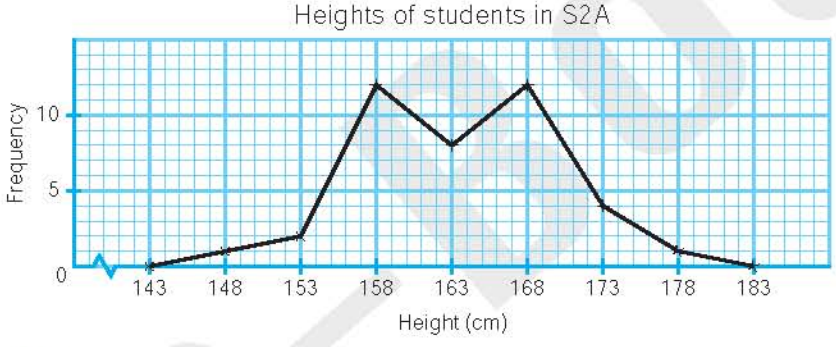
| Temperature (°C) | 22 - 24 | 25 - 27 | 28 - 30 | 31 - 33 | 34 - 36 |
|---|---|---|---|---|---|
| Frequency | 2 | 3 | 9 | 10 | 7 |

**7.** The table below shows the distribution of daily wages of 35 workers. Find the modal class of daily wages.

| Daily wage ($) | 220 - 229 | 230 - 239 | 240 - 249 | 250 - 259 | 260 - 269 | 270 - 279 |
|---|---|---|---|---|---|---|
| Frequency | 3 | 5 | 8 | 6 | 8 | 5 |

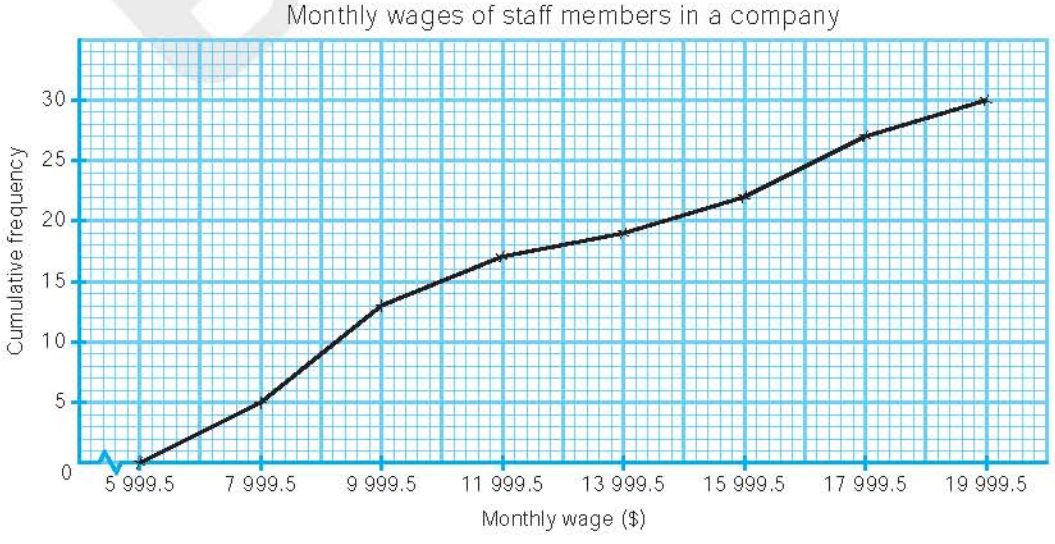
**8.** The histogram below shows the dining times of a group of customers in a sushi restaurant. Given that the first class interval is 20 minutes - 29 minutes, find the modal class of dining times.


**9.** The frequency polygon below shows the height distribution of students in S2A. It is given that the first class interval is 146 cm - 150 cm. Find the modal class of the heights.




## Level 2

**10.** The cumulative frequency polygon below shows the monthly wages of the staff members in a company.




**(a)** How many staff members are there in the company?

**(b)** Given that the first class interval is \$6 000 - \$7 999, complete the following frequency distribution table.

| Monthly wage (\$) | Frequency |
|---|---|
| 6 000 - 7 999 | |
| 8 000 - 9 999 | |
| | |
| | |
| | |
| | |
| | |

**(c)** Find the modal class of the staff members' monthly wages.

**11.** The table below shows the rental payments of two groups of people living alone. Each group has 80 people.

| Rent (\$) | 2 000 - 2 900 | 3 000 - 3 900 | 4 000 - 4 900 | 5 000 - 5 900 | 6 000 - 6 900 |
|---|---|---|---|---|---|
| Group A | 30 | 24 | 14 | 6 | 6 |
| Group B | 16 | 26 | 18 | 12 | 8 |

**(a)** Find the modal class of the rental payments of each group.

**(b)** Assume that people with higher income are willing to spend more on rent. By considering the modal classes, which group has higher income?

**12.** The back-to-back stem-and-leaf diagram below shows the distribution of Sharon's daily spending on breakfast from July to August.

Daily spending on breakfast

| July Leaf (\$1) | Stem (\$10) | August Leaf (\$1) |
|---|---|---|
| 8 8 8 6 6 6 | 0 | 6 6 6 8 8 8 9 9 9 |
| 8 8 8 8 8 8 5 5 5 2 2 2 2 0 0 0 0 | 1 | 0 0 0 0 2 2 5 5 5 5 5 5 8 8 8 |
| 5 5 2 0 0 0 0 0 | 2 | 0 0 0 0 0 2 5 |

**(a)** Find the mode of her daily spending on breakfast in July.

**(b)** Find the mode of her daily spending on breakfast in August.

**(c)** **(i)** Complete the following table to show the distribution of Sharon's daily spending on breakfast from July to August.

| Daily spending on breakfast (\$) | 6 | 8 | 9 | 10 | 12 | 15 | 18 | 20 | 22 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 6 | 6 | | | | | | | | |

**(ii)** Find the mode of Sharon's spending on breakfast from July to August. Is the result the same as those in **(a)** and **(b)**?

**13.** The mode and median of 2, 3, 3, 4, 4, 5, 6, $x$, $x + 2$ are 3 and 4 respectively. If $x$ is a positive integer, find the value of $x$.

**14.** Write down a set of 7 numbers which are not all the same, but both their mean and median are 7.

**15.** Write down a set of 5 numbers such that their mean, median and mode are 3, 2 and 1 respectively.

**16.** The heights of 6 players of a girls' volleyball team are not all the same, where the mean height is 2 cm more than the median height, and the median height is 3 cm more than the mode of the heights. Write down a possible set of their heights.

## Chapter Summary

Chapter Summary

### Fact to Remember

**1.** Mean

$$\text{Mean} = \frac{\text{Sum of all the data}}{\text{Number of data}}$$

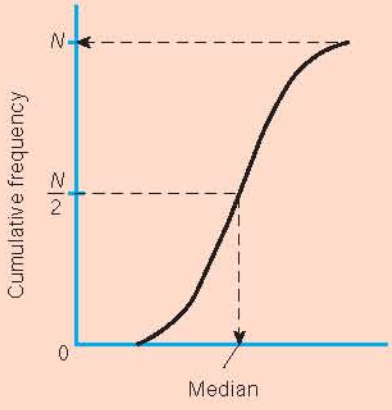
**2.** Median

**(a)** For a set of $n$ data arranged in ascending or descending order,

**(i)** if $n$ is an odd number, the median = the middle term;

**(ii)** if $n$ is an even number, the median = the mean of the two middle terms.

**(b)** In a cumulative frequency polygon or a cumulative frequency curve, if the total frequency is $N$, the median is the value corresponding to the cumulative frequency of $\frac{N}{2}$.




**3.** Mode and modal class

**(a)** A mode is the data with the highest frequency in a set of data.

**(b)** A modal class is the class with the highest frequency in a set of grouped data.

# Check Yourself

[This is a quiz to remind you of the basic concepts you have learned in this chapter. Each question tests a concept under the section listed on the right. Failure in any part of a question indicates a need to do a revision on the section listed.]

Section

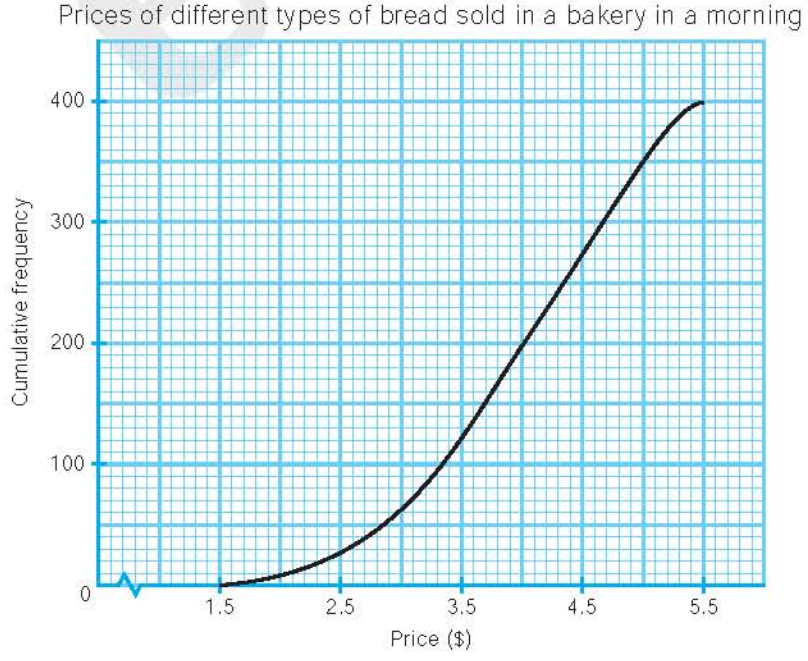
**1. (a)** The mean of 10, 12, 6, 5 and 9 is _____. 13.2

**(b)** The following frequency distribution table shows the weights of the members of a youth centre. Find the mean weight of the members of the youth centre.

| Weight (kg) | Class mark $x$ (kg) | Frequency $f$ | $fx$ (kg) |
|---|---|---|---|
| 53 - 55 | 54 | 3 | |
| 56 - 58 | 57 | 3 | |
| 59 - 61 | 60 | 10 | |
| 62 - 64 | 63 | 16 | |
| 65 - 67 | 66 | 12 | |
| 68 - 70 | 69 | 6 | |
| | Total | 50 | |

**2. (a)** The median of 10, 12, 6, 5 and 9 is _____. 13.3

**(b)** The following cumulative frequency curve shows the prices of different types of bread sold in a bakery in a morning. Find the median price of the bread sold.



**3.** **(a)** The mode of 10, 8, 8, 4, 3, 4, 8 and 9 is _____. 13.4

**(b)** The frequency distribution table of the heights of a group of males is shown as follows. Find the modal class of their heights.

| Height (cm) | 140 - 149 | 150 - 159 | 160 - 169 | 170 - 179 | 180 - 189 |
|---|---|---|---|---|---|
| Frequency | 23 | 36 | 47 | 40 | 20 |

## Revision Exercise 13

### Level 1

**1.** Find the mean, median and mode of each of the following sets of data.

**(a)** 4, 5, 6, 6, 7, 8

**(b)** 23, 32, 21, 30, 26, 30, 34

**(c)** 105, 110, 102, 111, 102

**(d)** 24, 21, 25, 20, 27, 21

**2.** In the following paragraph *extracted* from a *government press release*, what value should be filled in the blank?

'The peak period of Cross-boundary traffic during the Ching Ming and Easter holidays will fall between 3rd April to 16th April 2007. It is anticipated that 4.22 million people will pass through *Lo Wu Control Point*, i.e. an average of _____ thousand people daily …'

(Give your answer correct to 3 significant figures.)

**3.** In a flag day, a district raised $30 380, and the mean amount raised by the volunteers was $868. How many volunteers in the district participated in the flag day?

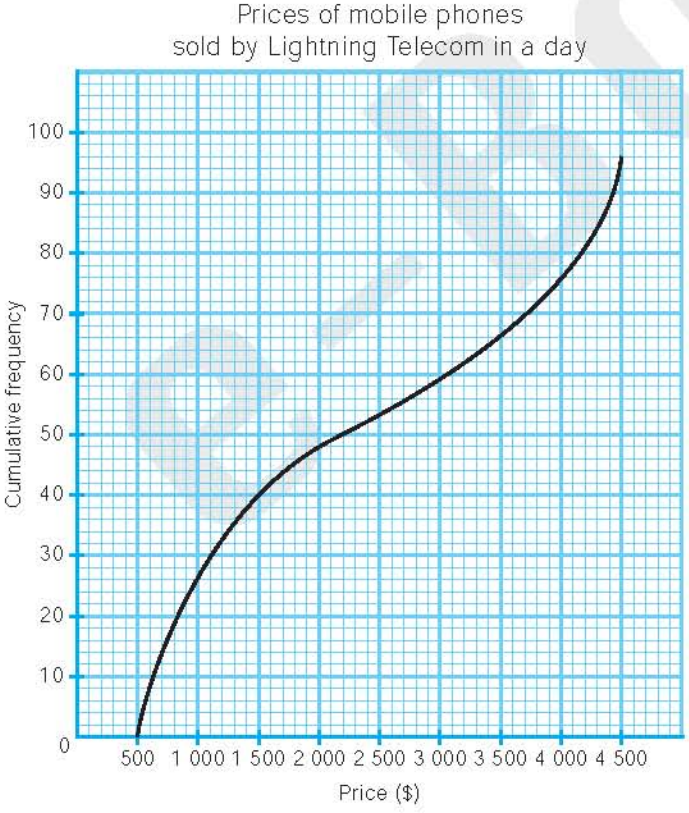
**4.** The following represents the number of strokes hit by a golf player over the last 10 matches, where '+3' means 3 strokes above standard, '−1' means 1 stroke below standard, and so on. If the number of standard strokes is 72, find the median number of strokes hit by the golf player.

+2, +1, −2, 0, +1, −1, 0, −3, +4, +1

extract 節錄　　government press release 政府新聞稿
Lo Wu Control Point 羅湖管制站

5. The pictogram shows the most favourite male singers with 390 people. Find the mode of the most favourite male singers.


6. The cumulative frequency curve shows the prices of mobile phones sold by Lightning Telecom in a day. Find the median price of mobile phones sold.




7. The following are the times (in minutes) required by Wilson to complete 8 crossword puzzles. Find the mean and median of the times required.
15.5, 18, 16, 12.5, 17.5, 14, 19.5, 10

**8.** Based on the given menu, find the mean, median and mode of the prices of the lunch sets.

**Today's Lunch Set**

| | | |
|---|---|---|
| A. | Yang Zhou Fried Rice | $28 |
| B. | Rice with grilled porkchop | $30 |
| C. | Spaghetti with meat paste | $30 |
| D. | Rice with curry chicken | $28 |
| E. | Fried noodles with pork | $28 |
| F. | Soup noodles with BBQ pork | $28 |
| G. | Rice with assorted meat | $24 |
| H. | Jumbo prawn salad | $32 |

**9.** The following table shows the distribution of monthly wages of some factory workers. Find the mean, median and mode of the workers' monthly wages.

| Monthly wage | $7 500 | $8 000 | $9 000 | $10 000 |
|---|---|---|---|---|
| Frequency | 10 | 35 | 30 | 25 |

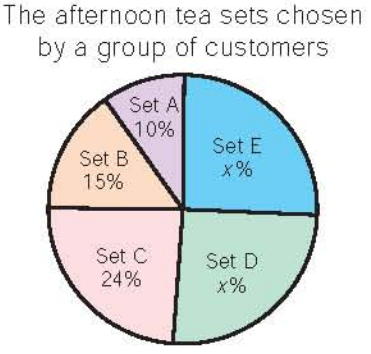
**10.** The following table shows the age distribution of 100 women when they gave birth for the first time. Find the mean and modal class of the ages.

| Age | 16 - 20 | 21 - 25 | 26 - 30 | 31 - 35 | 36 - 40 |
|---|---|---|---|---|---|
| Frequency | 2 | 18 | 30 | 38 | 12 |

**11.** The given pie chart shows the afternoon tea sets chosen by a group of customers.

**(a)** Find the value of $x$.

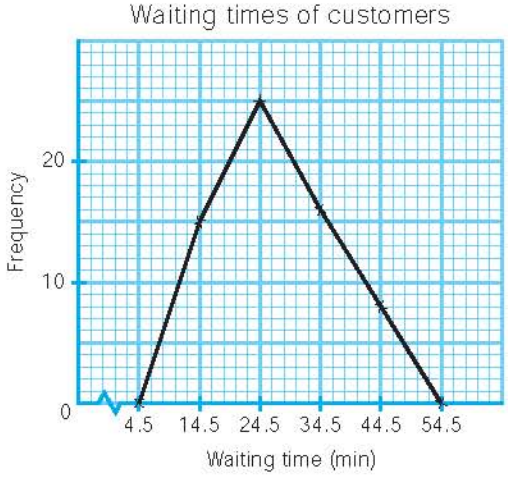
**(b)** Find the mode of the afternoon tea sets chosen.




**12.** The given frequency polygon shows the waiting times of customers in a restaurant. It is given that the first class interval is 10 minutes - 19 minutes.

**(a)** Find the mean waiting time. (Give your answer correct to 3 significant figures.)

**(b)** Find the modal class of the waiting times.




## Level 2

**13.** Clara bought 5 pieces of clothes in shop A and the mean price is $80. She bought another 3 pieces of clothes in shop B and the mean price is $92. Find the mean price of these 8 pieces of clothes.

**14.** The following table shows the times (in seconds) required for Dickson to swim 50 m during his *butterfly stroke* practice on 1st April and 1st May.

| | | | | | |
|---|---|---|---|---|---|
| 1st April | 30.08 | 29.92 | 31.02 | 31.54 | 30.82 |
| 1st May | 29.98 | 31.04 | 30.26 | 30.66 | 30.18 |

**(a)** Find the mean time required for him to swim 50 m on each day.

**(b)** On which day did he perform better?

**15.** Find the mean, median and mode of the following set of data.

$a-8,\ a+6,\ a+4,\ a+2,\ a+4,\ a-8,\ a+4,\ a$

**16.** Consider the following set of positive integers:

8, 6, 5, 8, 3, 4, $x$, 4

**(a)** If the mean is 5, find the value of $x$.

**(b)** If the median is 5, find the value of $x$.

**(c)** If the mode is 8, find the value of $x$.

**17.** Write down 5 numbers where 4 of them are larger than the mean of the 5 numbers.

**18.** Write down 6 numbers where mode < mean < median.

**19.** **(a)** According to the IQ of 40 people below, complete the frequency distribution table.

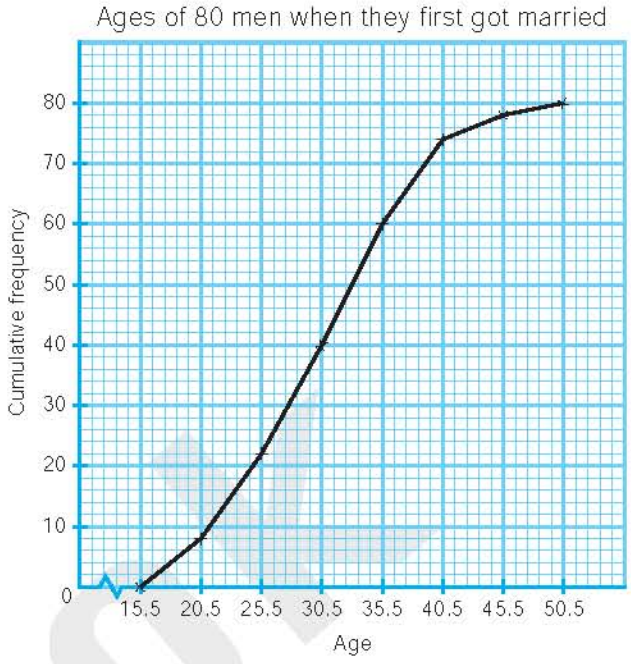
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 102 | 105 | 130 | 112 | 98 | 108 | 122 | 118 | 107 | 113 |
| 109 | 97 | 120 | 109 | 108 | 96 | 117 | 106 | 106 | 101 |
| 99 | 111 | 107 | 102 | 104 | 118 | 108 | 104 | 109 | 128 |
| 110 | 106 | 129 | 100 | 103 | 107 | 108 | 101 | 113 | 102 |

| IQ | Class mark | Tally | Frequency |
|---|---|---|---|
| 96 - 100 | | | |
| 101 - 105 | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**(b)** Find the mean IQ of these 40 people.

butterfly stroke 蝶泳

**20.** The cumulative frequency polygon shows the ages of 80 men when they first got married.




**(a)** Find the median age of the 80 men when they first got married.

**(b)** **(i)** It is given that the first class interval is 16 - 20. Complete the following frequency distribution table.

| Age | Frequency |
|---|---|
| 16 - 20 | |
| | |
| | |
| | |
| | |
| | |
| | |

**(ii)** Find the modal class of the ages of the 80 men when they first got married.

**(iii)** Find the mean age of the 80 men when they first got married. (Give your answer correct to 3 significant figures.)

**21.** The results of the Mathematics examination of the S2 classes in Hackin Secondary School are as follows.

| Class | S2A | S2B | S2C | S2D | S2E |
|---|---|---|---|---|---|
| Number of students | 38 | 40 | 42 | 33 | 38 |
| Mean Score | 80 | 70 | 75 | 65 | 69.5 |
| Median Score | 76 | 73 | 69 | 66 | 67 |
| Mode of Scores | 81 | 69 | 72 | 69 | 68 |

By considering all classes in S2, find each of the following. If any of the following cannot be found, explain briefly.

**(a)** Mean score

**(b)** Median score

**(c)** Mode of scores

**22.** In 5 dictations, Ricky's and Thompson's mean marks are 70 and 30 respectively. Among these 10 marks, one of them is a 100, one of them is a 0, and the full marks for each dictation is 100. Must Ricky be the one who gets 100 marks? Must Thompson be the one who gets 0 mark? Explain briefly with an example.

**23.** The back-to-back stem-and-leaf diagram shows the typing speed distribution (in word/min) of groups A and B, where $a$, $b$ and $c$ are non-negative integers less than 10. Each group has 30 people.

The typing speeds of 2 groups

| Group A Leaf (1 word/min) | Stem (10 words/min) | Group B Leaf (1 word/min) |
|---|---|---|
| 9 8 8 | 3 | 0 1 2 $a$ 2 5 8 |
| 9 $b$ 8 5 5 2 2 0 | 4 | 1 1 2 3 4 4 5 5 6 8 8 9 |
| 8 8 6 6 5 5 4 3 3 2 | 5 | 0 0 2 7 7 8 |
| 8 8 7 6 4 2 0 | 6 | 0 0 1 2 7 |
| 2 $c$ | 7 | |

**(a)** Find all possible values of $a$, $b$ and $c$.

**(b)** **(i)** Find the median typing speed of group A.

**(ii)** Find the median typing speed of group B.

**(c)** According to the results of **(b)**, which group has a higher typing speed?

## MC Question

**24.** Find the mean of the following set of data.

6, 6, 3, 12, 13, 8

**A.** 6
**B.** 7
**C.** 8
**D.** 8.4

**25.** Find the median of the following set of data.

8, 4, 5, 1, 3, 6, 3, 2

**A.** 2
**B.** 3
**C.** 3.5
**D.** 4

**26.** The table below shows the sport shoe sizes of a group of students. Find the mode of the sport shoe sizes.

| Size | 6 | 7 | 8 | 9 |
|---|---|---|---|---|
| Frequency | 9 | 8 | 10 | 7 |

**A.** 7
**B.** 8
**C.** 9
**D.** 10

**27.** If the mean of 1, 2, 3, 4 and $x$ is 5, find the value of $x$.

**A.** 2.5
**B.** 3
**C.** 5
**D.** 15

**28.** Consider the following set of data arranged in ascending order.

12, 12, 13, 14, $a$, 15, 16, 16, 18, 20

If the median is 14.5, find the value of $a$.

**A.** 14.2
**B.** 14.25
**C.** 14.5
**D.** 15

**29.** During a week, the mean daily rainfall from Monday to Friday was 12 mm, and the mean daily rainfall for the whole week was 18 mm. Find the total rainfall on Saturday and Sunday that week.

**A.** 6 mm
**B.** 30 mm
**C.** 42 mm
**D.** 66 mm

# Problem-solving and Exploring

## Hint for the Title Page Question

**(a)** What is the total weight of the 39 students?

**(b)** After the addition of the new student, what is the total weight of the 40 students?

**(c)** Find the weight of the new student.

## Additional Question

**1.** The following table shows the number of words in three passages, and the time required for Sally to finish typing them up.

| | Number of words | Time (min) |
|---|---|---|
| Passage A | 1 200 | 20 |
| Passage B | 1 500 | 20 |
| Passage C | 900 | 15 |


It is given that typing speed $= \dfrac{\text{Number of words}}{\text{Time}}$.

**(a)** **(i)** Find Sally's typing speed of each passage.

**(ii)** From **(a)(i)**, find her mean typing speed.

**(b)** Find the mean number of words of these three passages.

**(c)** Find the mean time required to type up these three passages.

**(d)** Using the results above, determine whether the statement below is true.

$$\text{Mean typing speed} = \frac{\text{Mean number of words}}{\text{Mean time required}}$$

**2.** Choose a question you are interested in and conduct a statistical survey on it (e.g. the number of late arrivals and absences in your class last month).

**(a)** Make a guess at the mean, median and mode in your question.

**(b)** Choose an appropriate method of collecting data and find the mean, median and mode with the data collected.

**(c)** How well do your guesses match the results of your survey?